Active Pixel HgCdTe Detectors With Built-in Dark Current Reduction for Near-Room Temperature Operation, Phase I

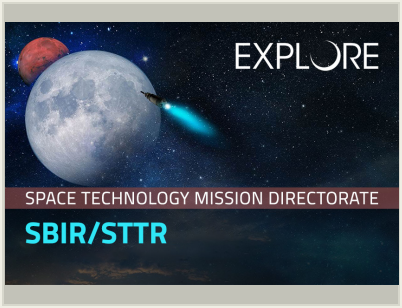
Completed Technology Project (2005 - 2005)

Project Introduction

High sensitivity HgCdTe infrared arrays operating at 77K can now be tailored in a wide range of wavelengths from 1 to14 um. However, the cooling requirements make them bulky and unsuitable to be incorporated into robust autonomous sensor systems. We propose to develop detectors with high detectivity that operates at or near room temperature in the MWIR (3 to 5 um) and LWIR (8 to 12 um) atmospheric windows. These detectors are based on the active regions with HgCdTe bulk alloy layer and a secondary HgCdTe bulk alloy layer, which serves as a sink for both the dark and background currents. Room temperature or moderately cooled operation of these detectors is achieved by suppressing the Auger and radiative recombination mechanisms. We will also incorporate in each pixel a dynamic skimming that will reduce the effect of dark and background currents while enhancing the dynamic range. Therefore, we are designing detectors that are read out integrated circuit (ROIC) friendly. We plan to achieve these objectives by combining the advantages of the molecular beam epitaxy (MBE) crystal growth technique, an innovative nonequilibrium device architecture, photon recycling concepts, dynamic dark current skimming, and optimized read out circuit that will increase the operating temperature. High quality HgCdTe layers (for infrared detection) will be grown on large area (3-5") silicon substrates. This will make it possible to produce rugged, low-cost, large area focal plane arrays with higher operating temperatures and near-BLIP performance

Anticipated Benefits

Near room temperature focal plane arrays will find enormous applications in military, space and medical imaging areas for infrared imaging. Another area where these detectors will find enormous application is in the automobile industry, for example as driver's navigation aids in nighttime and foggy weather conditions. EPIR Technologies is fully committed to fabricate and commercialize uncooled infrared detectors and arrays if this program is successful. Near room temperature FPAs will be suitable for space-based spectroscopic applications. HgCdTe-based devices, with the advantages of small electron mass, high mobilities, and large electron saturation velocities have considerable benefits for a variety of new micro-electronic and optoelectronic applications, if near room temperature operation is achieved with a nonequilibrium mode of operation. As a consequence of negative luminescence at ambient temperatures, nonequilibrium devices cool their surroundings, thus creating the potential for a new application, "radiation coolers".



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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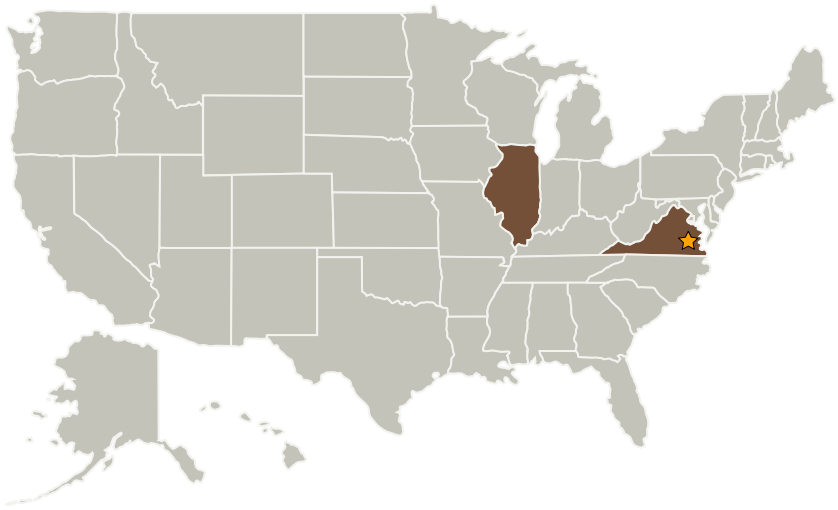
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
EPIR Technologies, Inc.	Supporting Organization	Industry Small Disadvantaged Business (SDB)	Bolingbrook, Illinois

Primary U.S. Work Locations	
Illinois	Virginia

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Project Manager:
Ken Tedjojuwono

Principal Investigator:
Silviu Velicu

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes